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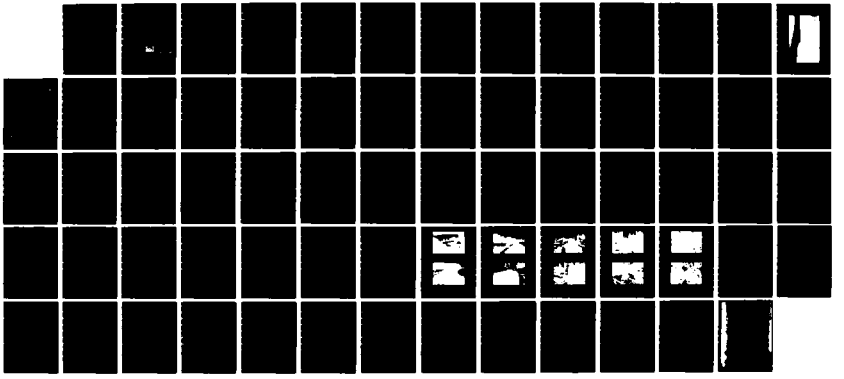

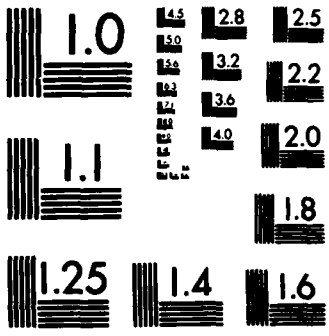

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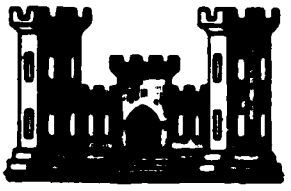
HOUSATONIC RIVER BASIN,
DANBURY, CONNECTICUT.

WEST LAKE RESERVOIR DAM
CT 00070

PHASE I INSPECTION REPORT.
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle) Housatonic River Basin Danbury Conn., West Lake Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Housatonic River Basin
Danbury Conn., West Lake Reservoir Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The West Lake Reservoir Dam is an earth embankment that is approx. 450 ft. long and 31.7 ft. high. The embankment has 1.5:1 side slopes and has puddled clay gravel core. The spillway is located through the northern abutment of the dam and consists of a 120-ft. long concrete weir. There are upper and lower gate houses for the control of a 30-inch water main and a 24-inch blowoff that passes through the base of the dam. The valves for the operation of the water main and the blowoff are in the lower gate house and are inoperable. The drainage area is 3.3 square miles and the reservoir has 3,430 acre-feet of available storage.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

6 OCT 19..

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the West Lake Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, City of Danbury, Connecticut.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

A1

WEST LAKE RESERVOIR DAM

CT 00070

HOUSATONIC RIVER BASIN

DANBURY, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification Number:	CT 00070
Name:	West Lake Reservoir Dam
State Location:	Connecticut
County Location:	Fairfield
Stream:	Tributary to Padanaram Brook
Date of Inspection:	April 21, 1980

BRIEF ASSESSMENT

The West Lake Reservoir Dam is an earth embankment that is approximately 450 feet long and 31.7 feet high. The embankment has 1.5:1 side slopes and has a puddled clay and gravel core. The spillway is located through the northern abutment of the dam and consists of a 120-foot long concrete weir. There are upper and lower gate houses for the control of a 30-inch water main and a 24-inch blowoff that passes through the base of the dam. The valves for the operation of the water main and the blowoff are in the lower gate house and are inoperable. The drainage area is 3.3 square miles and the reservoir has 3,430 acre-feet of available storage.

The assessment of the dam is based on the visual inspection, past operational performance and hydraulic/hydrologic computations. The dam is judged to be in fair condition with several areas that require attention. These areas include seepage through the dam and along the toe, steepness of the embankment, vegetation on the embankments, along the toe of the dam and in the spillway channel and the nonoperating status of the blowoff.

The dam is classified as intermediate and has a high hazard potential in accordance with guidelines established by the Corps of Engineers. The test flood for this dam is 1/2 the Probable Maximum Flood (PMF). The test flood inflow is 6,520 cfs and the routed test flood outflow is 3,890 cfs. The test flood outflow will overtop the dam by 1.0 feet.

It is recommended that the owner engage the services of a qualified registered engineer experienced in the design of dams to investigate the seepage through the dam, the steepness of the embankment and prepare a detailed hydraulic/hydrologic study to determine the spillway's adequacy. It is also recommended that the owner clear the spillway channel; remove vegetation from the downstream face; repair the discharge valve; check the erosion on the adjacent hill; establish a formal warning system and initiate a program of operation and maintenance and an annual technical inspection.

The owner should implement the recommendations and remedial measures described above and in greater detail in Section 7 within one year after receipt of this Phase I Inspection Report.

Joseph F. Merluzzo
Connecticut P.E. #7639
Project Manager

Gary J. Giroux
Connecticut P.E. #11477
Project Engineer

This Phase I Inspection Report on West Lake Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Inspections. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Inspection; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Test Flood is based on the estimated Probable Maximum Flood for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and variety of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Inspection does not include an assessment of the need for fences, gates, "no trespassing" signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with Occupational Safety and Hazard Administration's (OSHA) rules and regulations is also excluded.

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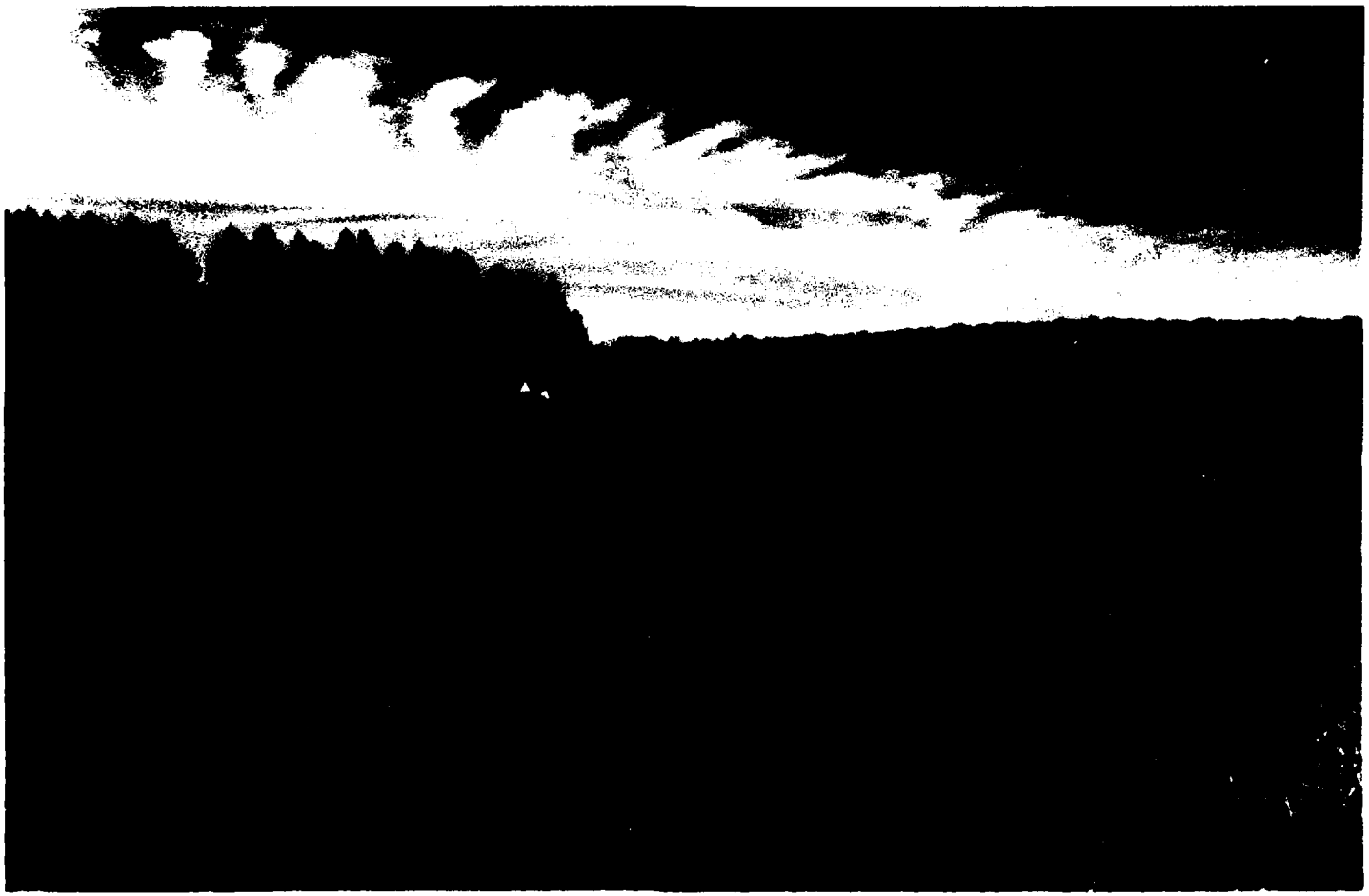
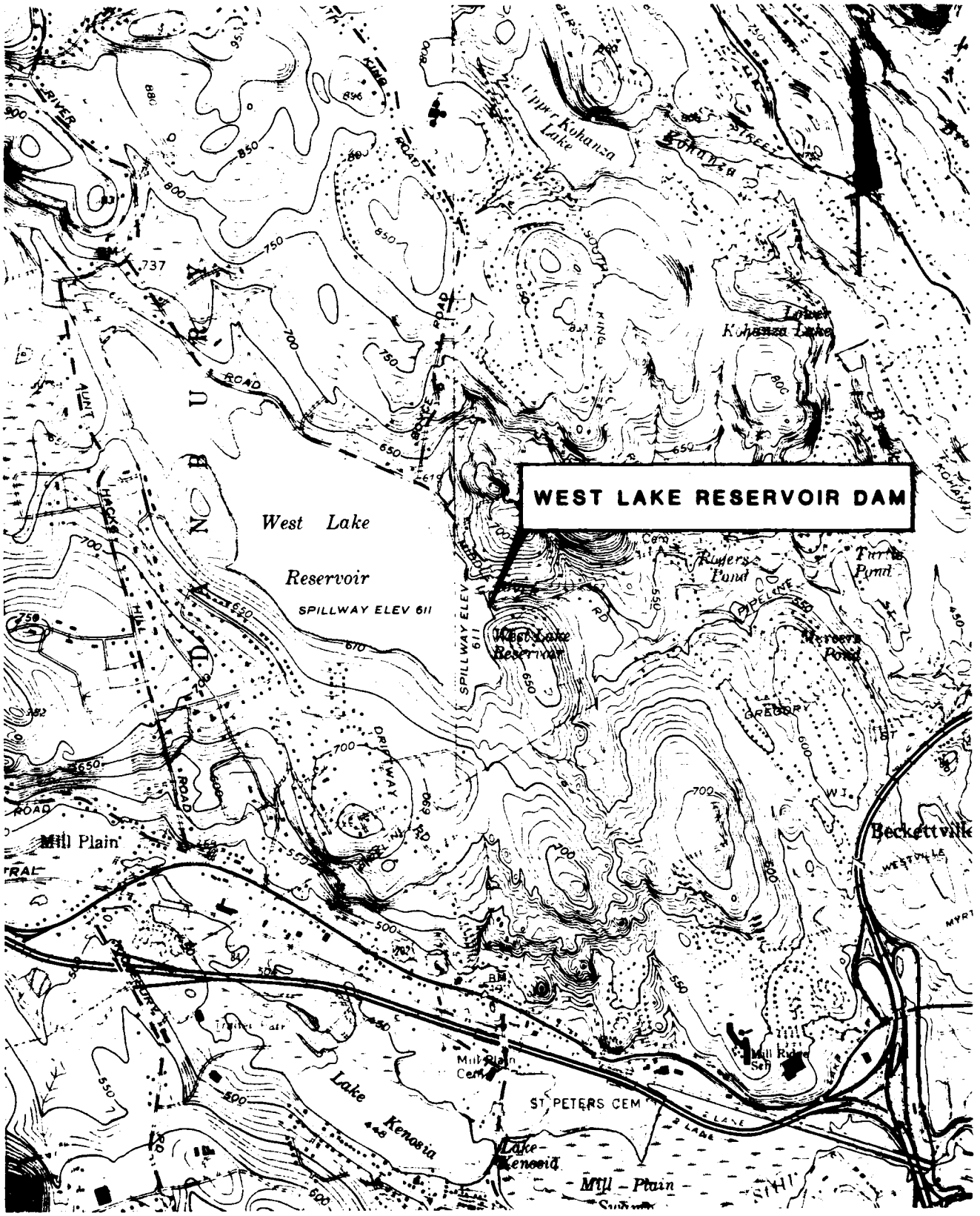


WEST LAKE RESERVOIR DAM



QUADRANGLE. **DANBURY, CT**

US ARMY, CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASS.

SCALE IN FEET
2000' 0 2000' 4000'
1" = 2000

LOCATION MAP

PHASE I INSPECTION REPORT

WEST LAKE RESERVOIR DAM CT 00070

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspections throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Storch Engineers has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Storch Engineers under a letter of March 6, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0035 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection -

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location - The West Lake Reservoir Dam is located approximately 1-3/4 miles northwest of the Route 7 and Interstate 84 interchange in the City of

Danbury, Connecticut (See Location Map). The coordinates of the dam are approximately 41°-24.25' north latitude and 73°-30' west longitude. The dam is located on a tributary of Padanaram Brook in the Housatonic River Basin.

b. Description of Dam and Appurtenances - The West Lake Reservoir Dam is an earth embankment that is 450 feet long and 31.7 feet high. The embankment is fairly steep with 1.5:1 slopes on both the upstream and downstream face. There is a puddled clay and gravel core through its entire length.

The spillway is located through the northern abutment of the dam and consists of a 120-foot long concrete weir. A grass lined channel 90 feet wide and 350 feet long is upstream of the weir. Downstream is a steep concrete channel 18 feet wide.

There are upstream and downstream gate houses with screens in the upper house and valves in the lower house. A 30-inch water main passes through the base of the dam with a 24-inch blowoff branching off at the lower gate house. The water main feeds in the City of Danbury's water system. The valves in the lower gate house are not operable and the water main is controlled at the City's filtration plant.

c. Size Classification - The West Lake Reservoir Dam has a maximum height of 31.7 feet and a maximum storage of 3,430 acre-feet at the top of the dam. In accordance with the Recommended Guidelines for Safety Inspection of Dams established by the Corps of Engineers, the dam is classified as intermediate (height 40 to 100 feet and storage 1,000 to 50,000 acre-feet).

d. Hazard Classification - The West Lake Reservoir Dam is classified as having a high hazard potential. Failure of the dam could result in the loss of more than a few lives and cause significant property damage. Approximately 7,300 feet downstream is a nursing home built immediately adjacent to the

brook. The first floor sill of the nursing home is approximately 7 feet above the streambed. Estimated flow and water depths just prior to dam failure at this location is 2,000 cfs at 4.2 feet and just after dam failure is 33,260 cfs at 16.5 feet. Failure of West Lake Reservoir Dam will also cause overtopping and consequently failure of Mercers Pond Dam which is approximately 700 feet upstream from the nursing home. Also, the "local protection works" for the Still River through Danbury is designed for 6,900 cfs. The flood wave when it hits these works will be 18,000 cfs or almost three times the capacity. This will cause inundation of one to two feet at several locations in downtown Danbury.

e. Ownership - The West Lake Reservoir Dam is owned by the City of Danbury, Connecticut.

f. Operator - The person in charge of day-to-day operation of the dam is:

Mr. John A. Schweitzer, Jr.
City Engineer
City of Danbury
Danbury, Connecticut 06810
(203) 797-4641

g. Purpose of Dam - The dam impounds the West Lake Reservoir which serves as a primary water supply for the City of Danbury.

h. Design and Construction History - The West Lake Reservoir Dam was constructed around 1905. There are no design computations available. Construction drawings for the dam are available. These drawings were prepared by W. S. Morton, Consulting Engineer in 1905.

i. Normal Operational Procedure - Water level in West Lake Reservoir Dam is controlled by flow through the water main and over the spillway. The only periodic dam maintenance is grass cutting.

1.3 Pertinent Data

a. Drainage Area - The West Lake Reservoir drainage basin is in the City of Danbury and is irregular in shape. The area of the drainage basin is 3.3 square miles (Appendix D - Plate 3). Approximately 10 percent of the drainage basin is natural storage and more than 50 percent is undeveloped. The topography is rolling with elevations ranging from 1,067 (NGVD) to 611 (NGVD) at the spillway crest.

b. Discharge at Damsite - There are no records available for discharge at the dam.

(1)	Outlet works (conduit) size:	30 inches
	Invert elevation (feet above NGVD):	585.7
	Discharge Capacity at top of dam:	150 cfs
(2)	Maximum known flood at damsite:	1,900 cfs
(3)	Ungated spillway capacity at top of dam:	1,950 cfs
	Elevation (NGVD):	614.7
(4)	Ungated spillway capacity at test flood elevation:	2,850 cfs
	Elevation (NGVD):	615.7
(5)	Gated spillway capacity at normal pool elevation:	N/A
	Elevation (NGVD):	N/A
(6)	Gated spillway capacity at test flood elevation:	N/A
	Elevation:	N/A
(7)	Total spillway capacity at test flood elevation:	2,850 cfs

	Elevation (NGVD):	615.7
(8)	Total project discharge at top of dam:	2,100 cfs
	Elevation (NGVD):	614.7
(9)	Total project discharge at test flood elevation:	3,890 cfs
	Elevation (NGVD):	615.7

c. Elevation (feet above NGVD)

(1)	Streambed at toe of dam:	583
(2)	Bottom of cutoff:	unknown
(3)	Maximum tailwater:	588
(4)	Normal pool:	611.2
(5)	Full flood control pool:	N/A
(6)	Spillway crest (ungated):	611.2
(7)	Design surcharge (original design):	unknown
(8)	Top of dam:	614.7
(9)	Test flood surcharge:	615.7

d. Reservoir (length in feet)

(1)	Normal pool:	7,000
(2)	Flood control pool:	N/A
(3)	Spillway crest pool:	7,000
(4)	Top of dam:	7,200
(5)	Test flood pool:	7,500

e. Storage (acre-feet)

(1)	Normal pool:	2,440
(2)	Flood control pool:	N/A
(3)	Spillway crest pool:	2,440

(4)	Top of dam:	3,430
(5)	Test flood pool:	3,690
f.	Reservoir Surface (acres)	
(1)	Normal pool:	248
(2)	Flood control pool:	N/A
(3)	Spillway crest:	248
(4)	Test flood pool:	268
(5)	Top of dam:	264
g.	Dam	
(1)	Type:	earth embankment
(2)	Length:	450 feet
(3)	Height:	31.7 feet
(4)	Top width:	15 feet
(5)	Side slopes:	1.5:1
(6)	Zoning:	unknown
(7)	Impervious core:	puddled clay and gravel
(8)	Cutoff:	unknown
(9)	Grout curtain:	unknown
(10)	Other:	N/A
h.	Diversion and Regulating Tunnel	N/A
i.	Spillway	
(1)	Type:	concrete-broad crested
(2)	Length of weir:	120 feet
(3)	Crest elevation (without flashboard):	611.2
(4)	Gates:	N/A
(5)	U/S channel:	90-foot wide - 2:1 side slopes

(6)	D/S channel:	stone and concrete apron-natural channel
(7)	General:	control is the U/S channe

j. Regulating Outlets

(1)	Invert elevation (NGVD):	585
(2)	Size:	30 inches
(3)	Description:	cast iron pipe
(4)	Control Mechanism	manually operated gate
(5)	Other:	gate not operable

SECTION 2 - ENGINEERING DATA

2.1 Design Data

There are no design computations available; however, there are drawings for the dam. These drawings show sections through the dam. A comprehensive study of the dam is presently underway by Flaherty-Giavara Associates, New Haven, Connecticut for the City of Danbury. This study is part of an overall study of the West Lake Reservoir Supply System.

2.2 Construction Data

The dam was constructed at the turn of the century, however, there are no records available for the construction.

2.3 Operation Data

The valves to the water main are not operated and are open all the time. Control of the water main is at the filtration plant. The valve to the 24-inch blowoff is closed. The pipe through the dam is under constant head at all times.

2.4 Evaluation of Data

a. Availability - There were no computations available, however, there are some drawings available. These drawings are available from the City of Danbury.

b. Adequacy - The information made available along with the visual inspection, past performance history and hydraulic/hydrologic assumptions were adequate to assess the condition of the facility.

c. Validity - Due to the lack of available data, the conclusions and recommendations found in this report are based on the visual inspection and hydraulic/hydrologic computations.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General - The visual inspection was conducted on April 21, 1980 by members of the engineering staff of Storch Engineers, D. Baugh and Associates, Inc. and Matthews Associates with the help of Mr. Bruce Healy of the City of Danbury, Connecticut. A copy of the visual inspection check list is contained in Appendix A of this report. Selected photos of the dam and appurtenant structures are contained in Appendix C.

In general, the overall appearance and condition of the facility and its appurtenant structures is fair.

b. Dam - The dam is an earth embankment with a puddled clay and gravel core. The downstream face is well vegetated with grass and some brush (Photo 1) and the slope is steep (1.5:1). Along the toe of the dam, there are trees and brush which obscured the view of the toe (Photo 9). The upstream face is in good condition with no signs of distress. The riprap protection shows no signs of erosion or sloughing (Photo 2). Along the southern abutment and on the downstream face, there is evidence of erosion from water running off the adjacent hill (Photo 7). The top of the dam is level with no signs of settlement.

Just below the toe of the dam, there is a steady seepage flow (Photo 9) which was estimated to be approximately 10 to 12 gallons per minute. This seepage is clear and does not show any signs of particle movement. The dam embankment is wet just to the south of the lower gate house (Photo 7). The amount of water at this location could not be measured.

c. Appurtenant Structures - The gate houses and service bridge (Photos 1 and 2) are in fair condition with no visible signs of cracking or distress. The water main is controlled by a valve at the filtration plant. The valve to the water main in the lower gate house is frozen in the open position. The valve to the blowoff in the lower gate house is frozen in the closed position.

The spillway is a concrete weir that is in good condition (Photo 4). The approach channel is a 90-foot wide channel that is overgrown with brush and grass (Photo 3). The approach channel is the actual control to the hydraulic capacity of the spillway. The downstream channel is a concrete and stone masonry channel that is 18 feet wide and 1.5 feet deep (Photos 4 and 5). The condition is good except for the bottom of the channel where debris is cluttered and there is some minor undermining (Photo 5).

d. Reservoir Area - The area immediately adjacent to the facility is gently sloped and in a natural state. The shoreline shows no signs of sloughing or erosion and there is no development adjacent to the reservoir. A rapid rise in the water level of the reservoir will not endanger any life or property.

e. Downstream Channel - The channel for the blowoff (Photo 6) is 2 feet wide, 2 feet deep and 100 feet long. The channel is in poor condition with the walls falling in and the channel bottom gone in sections.

The downstream channel is in a natural state (Photo 6a).

3.2 Evaluation

Overall, the general condition of the dam is fair. The visual inspection revealed items that lead to this assessment, and apparent areas of distress such as:

a. Seepage through the embankment and the toe.

b. Inoperation of the blowoff.

c. Undermining of the downstream spillway channel.

d. Vegetation on the downstream face along the toe of the dam and the downstream channel.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General - The operation of this facility is for water supply purposes and the reservoir is kept at or above the spillway crest. The 30-inch water main through the dam cannot be controlled at the dam, but is controlled at the filtration plant and the 24-inch blowoff is not used to lower the reservoir because the valve is frozen closed.

b. Description of any Warning System in Effect - There is no warning system in effect for this dam.

4.2 Maintenance Procedures

a. General - The only item maintained is the grass on the dam and that is not on a routine basis.

b. Operating Facilities - Valves at the dam are not operable.

4.3 Evaluation

The maintenance of the dam is less than adequate in that proper care of the dam embankment should be on a regular basis. Valves should be maintained in working order and there should be a proper operating procedure and warning system in effect.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The West Lake Reservoir Dam is an earth embankment approximately 450 feet long and 31.7 feet high. The dam has a puddled clay and gravel core. The spillway is a concrete weir, 120 feet long. The approach channel to the spillway is 90 feet wide with 2:1 side slopes. The downstream channel is 18 feet wide and is stone masonry. A 30-inch water main passes through the base of the dam with a 24-inch blowoff from the lower gate house. The valve to the blowoff is inoperable.

The watershed encompasses 3.3 square miles and is 50 percent developed. The topography is rolling with the terrain rising 456 feet from the spillway crest.

The pond has a total capacity of 3,430 acre-feet when the pond is at the top of the embankment and 2,440 acre-feet at the spillway crest. Therefore, there is approximately 990 acre-feet of storage available. The test flood outflow for this dam is 3,890 cfs and the spillway capacity is 1,950 cfs or approximately 50% of the test flood outflow.

5.2 Design Data

No design data is available.

5.3 Experience Data

The West Lake Reservoir Dam has experienced all the major storms of the 1930's and 1950's and most recently January, 1979. The flood of record resulted from the storm of October, 1955. No records are available for this flood, however, from visual observations by City personnel, the reservoir was near capacity (within 6 inches of the top of the dam). This gives an approximated flow of 1,900 cfs through the spillway. The dam has never been overtopped.

5.4 Test Flood Analysis

Based on the guidelines found in the Recommended Guidelines for Safety Inspection of Dams, the dam is classified as an intermediate structure with a high hazard potential. The test flood for these conditions is the Probable Maximum Flood (PMF).

Using the guide curves established by the Corps of Engineers (rolling terrain), the test flood inflow is 6,520 cfs. The routing procedure established by the Corps gives an approximate outflow of 3,890 cfs. The spillway capacity is approximately 1,950 cfs or approximately 50% of the test flood outflow. The test flood will overtop the dam by approximately 1 foot.

Storage behind the dam was assumed to begin at the spillway crest. Storage was determined by an average area depth analysis. Capacity curves for the spillway channel assumed open channel flow with the flow passing through critical depth at the end of the channel.

5.5 Dam Failure Analysis

A dam failure analysis was performed using the Rule of Thumb method in accordance with guidelines established by the Corps of Engineers. Failure was assumed to occur when the water level in the reservoir was at the top of the dam.

The spillway discharge just prior to dam failure is 1,950 cfs and will produce a depth of flow of approximately 2.5 feet several hundred feet downstream from the dam. The calculated dam failure discharge is 38,250 cfs and will produce a depth of flow of approximately 10 feet several hundred feet downstream from the dam or an increase in water depth at failure of approximately 7.5 feet. Approximately 7,300 feet downstream is a nursing home built immediately adjacent the brook. The first floor sill of the nursing

home is approximately 7 feet above the streambed. Estimated flow and water depths at this location just prior to dam failure is 2,000 cfs at 4.2 feet and just after dam failure is 33,600 cfs at 16.5 feet or an increase in depth of 11.5 feet. The failure analysis covered a distance of approximately 21,000 feet downstream where the flood wave would run into the "local protection works" in downtown Danbury. This protection works is designed for 6,900 cfs. Flow from dam failure would be 18,000 cfs.

Failure of the West Lake Reservoir Dam may result in the loss of more than a few lives and may damage at least 20 dwellings. Also, the flood wave will travel through the center of Danbury and may cause inundation of one to two feet at several locations.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The general structural stability of the dam is good as evidenced by the vertical, horizontal and lateral alignment of the embankment. The front face of the dam is fairly steep (1.5 to 1), and shows no apparent signs of distress. The embankment has a good vegetative cover and the riprap protection on the upstream face is in good condition. The spillway channel is in good condition and the blowoff channel is in poor condition.

Some possible problem areas are a wet spot on the embankment just south of the lower gate house, erosion on the south abutment/embankment interface (caused by surface runoff), and undermining at the end of the downstream channel of the spillway.

6.2 Design and Construction Data

The only construction data available was in the form of drawings. No design computations or construction reports are available.

6.3 Post-Construction Changes

No information on post-construction changes are available. However, comparing the drawings (sections) with actual conditions show a terraced area at the toe of the dam had been added (Appendix B - Plate 1).

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and in accordance with Recommended Phase I Guidelines does not warrant a seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - After consideration of the available information, the results of the inspection, contact with the owner and hydraulic/hydrologic computations, the general condition of the West Lake Reservoir Dam is fair.

b. Adequacy of Information - The information available is such that an assessment of the safety of the dam should be based on the available data, the visual inspection results, past operational performance of the dam and its appurtenant structures and computations developed for this report.

c. Urgency - It is considered that the recommendations suggested below be implemented within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

The following recommendations should be carried out under the direction of a qualified registered engineer.

a. Seepage through the dam and at the toe of the dam should be investigated further to determine its origin and monitored to determine any changes.

b. Structural stability of the embankment should be analyzed because of the steepness of the slopes.

c. Prepare a detailed hydraulic/hydrologic study to determine spillway adequacy and an increase of the total project discharge if necessary.

7.3 Remedial Measures

a. Operation and Maintenance Procedures -

(1) Spillway channel should be kept free of brush and grass.

(2) Downstream of the spillway channel should be cleared and stablized with riprap to prevent undermining.

(3) Vegetation on the downstream face of the dam and trees along the toe of the dam should be removed. This will facilitate the visual observation of existing and potential seepage.

(4) Discharge valve and pipe should be repaired. Valve for the discharge pipe should be on the upstream side of the embankment.

(5) Erosion from water running off the adjacent hill should be controlled with riprap or some other means.

(6) Plans for around-the-clock surveillance should be developed for periods of unusually heavy rains and a formal downstream warning system should be put into operation for use in the event of an emergency.

(7) Plans for a regular program of operation and maintenance at the dam should be initiated.

(8) A program of annual technical inspection should be established.

7.4 Alternatives

None.

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT WEST LAKE RESERVOIR DAM

DATE 4/21/80

TIME 8:30 a.m.

WEATHER Clear

W.S. ELEV. _____ U.S. _____ DN.S.

PARTY:

1. John F. Schearer, S.E. Civil
2. Kenneth J. Pudeler, S. E. Civil
3. Gary J. Giroux, S.E. Hyd/Civil
4. Michael Haire, DBA Struct/Geo.
5. Peter Austin, DBA Civil
6. Bruce Healy, Danbury
7. John Pozzato, M.A., Mech.
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

INSPECTION CHECK LIST

PROJECT WEST LAKE RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	Good
Current Pool Elevation	Good
Maximum Impoundment to Date	Good
Surface Cracks	N/A
Pavement Condition	N/A
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good - downstream, south side has some erosion due to runoff
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Problem
Vegitation on Slopes	Some
Sloughing or Erosion of Slopes or Abutments	Some - minor cutting
Rock Slope Protection - Riprap Failures	Good condition
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Some - negligible
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT WEST LAKE RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
CUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Underwater
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

INSPECTION CHECK LIST

PROJECT WEST LAKE RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	N/A
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

INSPECTION CHECK LIST

PROJECT WEST LAKE RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural Stone	
General Condition	Fair
Condition of Joints	OK
Spalling	N/A
Visible Reinforcing	N/A
Rusting or Staining of Concrete	N/A
Any Seepage or Efflorescence	N/A
Joint Alignment	OK
Unusual Seepage or Leaks in Gate Chamber	Filled with water
Cracks	N/A
Rusting or Corrosion of Steel	Pipe broken
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	30" Inlet valve, underwater, but was told it was not operatable.
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	None

INSPECTION CHECK LIST

PROJECT WEST LAKE RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL Stone Masonry	
General Condition of Concrete	N/A
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	None
Visible Reinforcing	N/A
Any Seepage or Efflorescence	Some - ground is wet around structure
Condition at Joints	OK
Drain holes	None
Channel	Fair
Loose Rock or Trees Overhanging Channel	Some
Condition of Discharge Channel	Poor - sides falling in.

INSPECTION CHECK LIST

PROJECT WEST LAKE RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Heavy grass and brush in places
b. Weir and Training Walls	
General Condition of Concrete	Fair
Rust or Staining	None
Spalling	Minor on sills
Any Visible Reinforcing	None
Any Seepage or Efflorescence	None
Drain Holes	None
c. Discharge Channel	
General Condition	Good except for bottom - some undermining at bottom
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Some
Floor of Channel	Concrete - good
Other Obstructions	Debris at outlet

INSPECTION CHECK LIST

PROJECT WEST LAKE RESERVOIR DAM DATE 4/21/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	Fair
Bearings	OK
Anchor Bolts	None observed
Bridge Seat	Concrete - OK
Longitudinal Members	Steel - OK
Under Side of Deck	Fair
Secondary Bracing	None observed
Deck	Wood - Fair
Drainage System	None
Railings	OK
Expansion Joints	None
Paint	Needs painting
b. Abutment & Piers	
General Condition of Concrete	Fair
Alignment of Abutment	Ok
Approach to Bridge	Good
Condition of Seat & Backwall	Fair

APPENDIX B

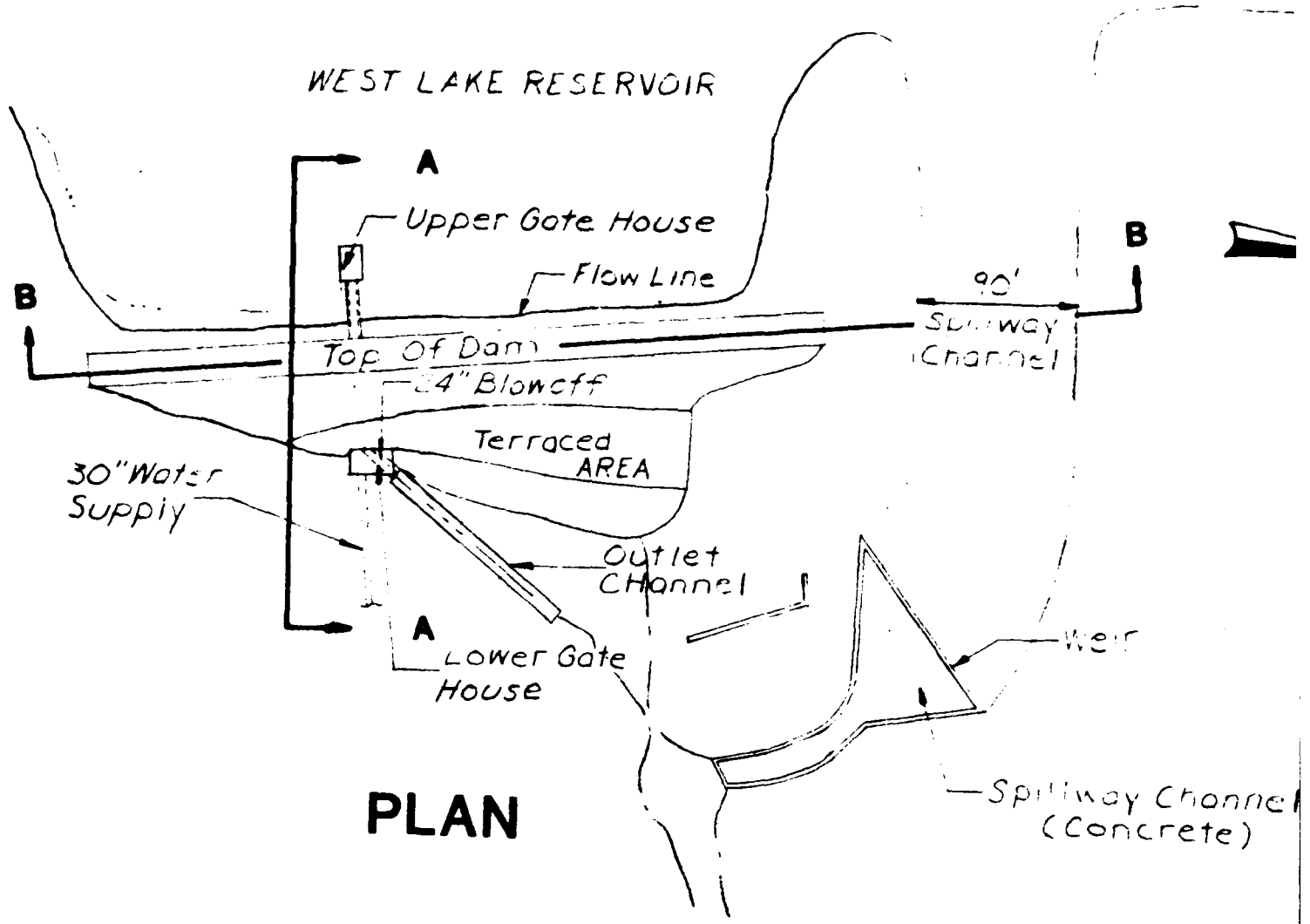
ENGINEERING DATA

Information pertaining to the history, maintenance and past inspection reports are located at:

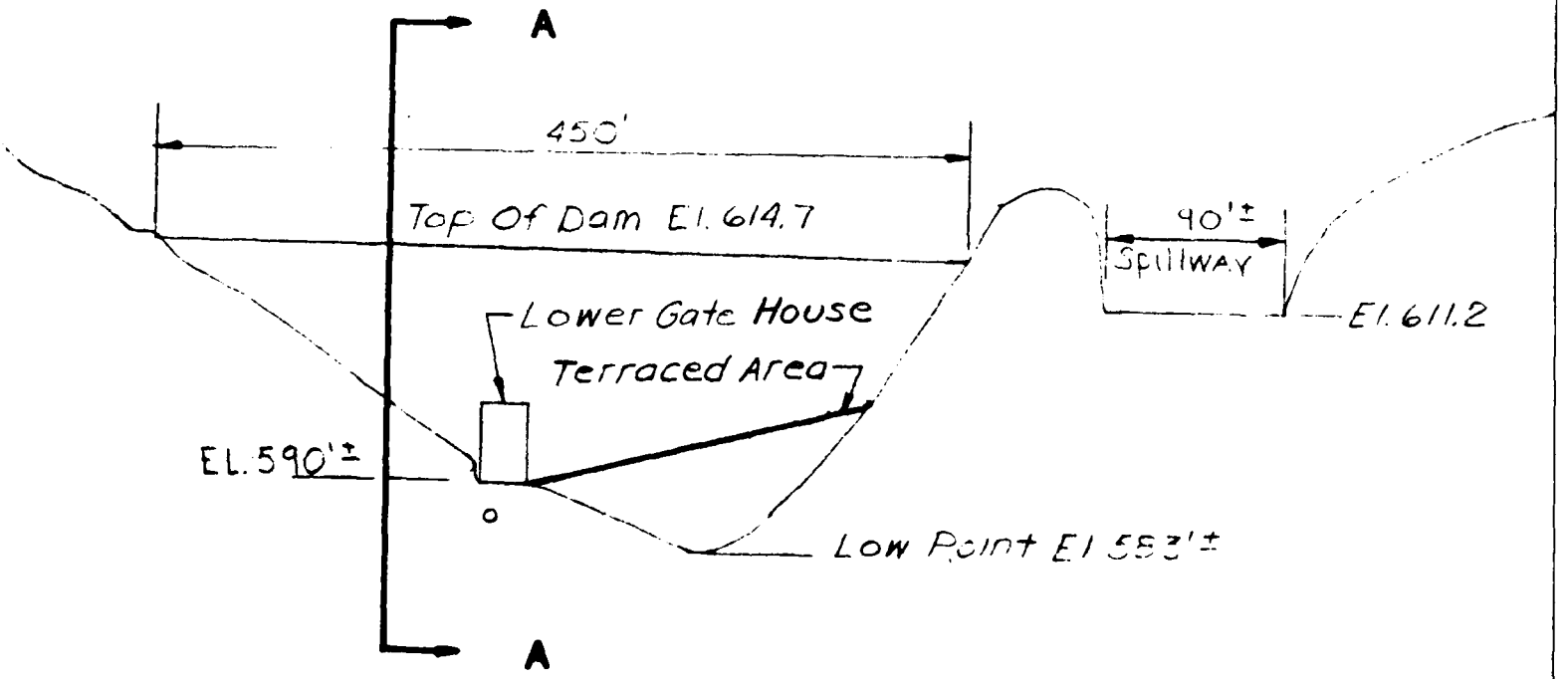
State of Connecticut
Department of Environmental Protection
Water Resources Unit
State Office Building
Hartford, Connecticut 06115

Plans are located at:

Engineering Department
City of Danbury
Danbury, Connecticut 06810

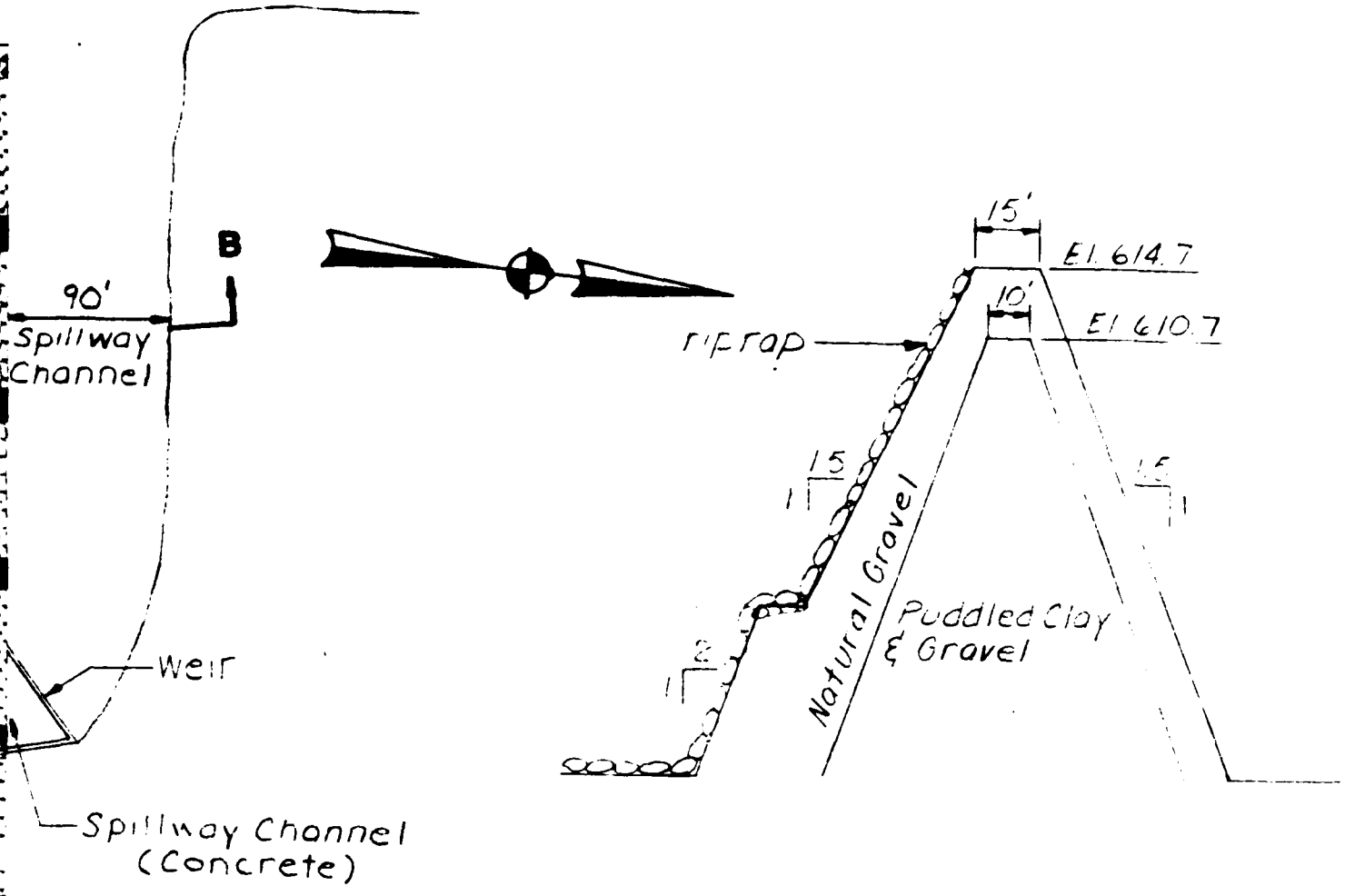


PLAN

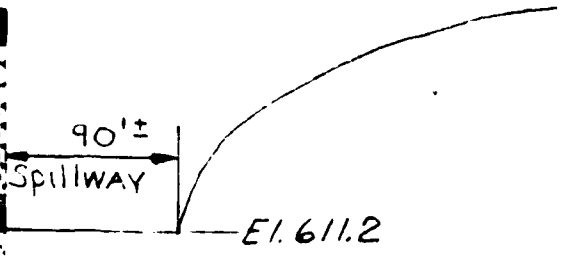


I **ELEVATION B-B**

NOT TO



SECTION A-A



583'±

PLATE 1

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

WEST LAKE RESERVOIR DAM

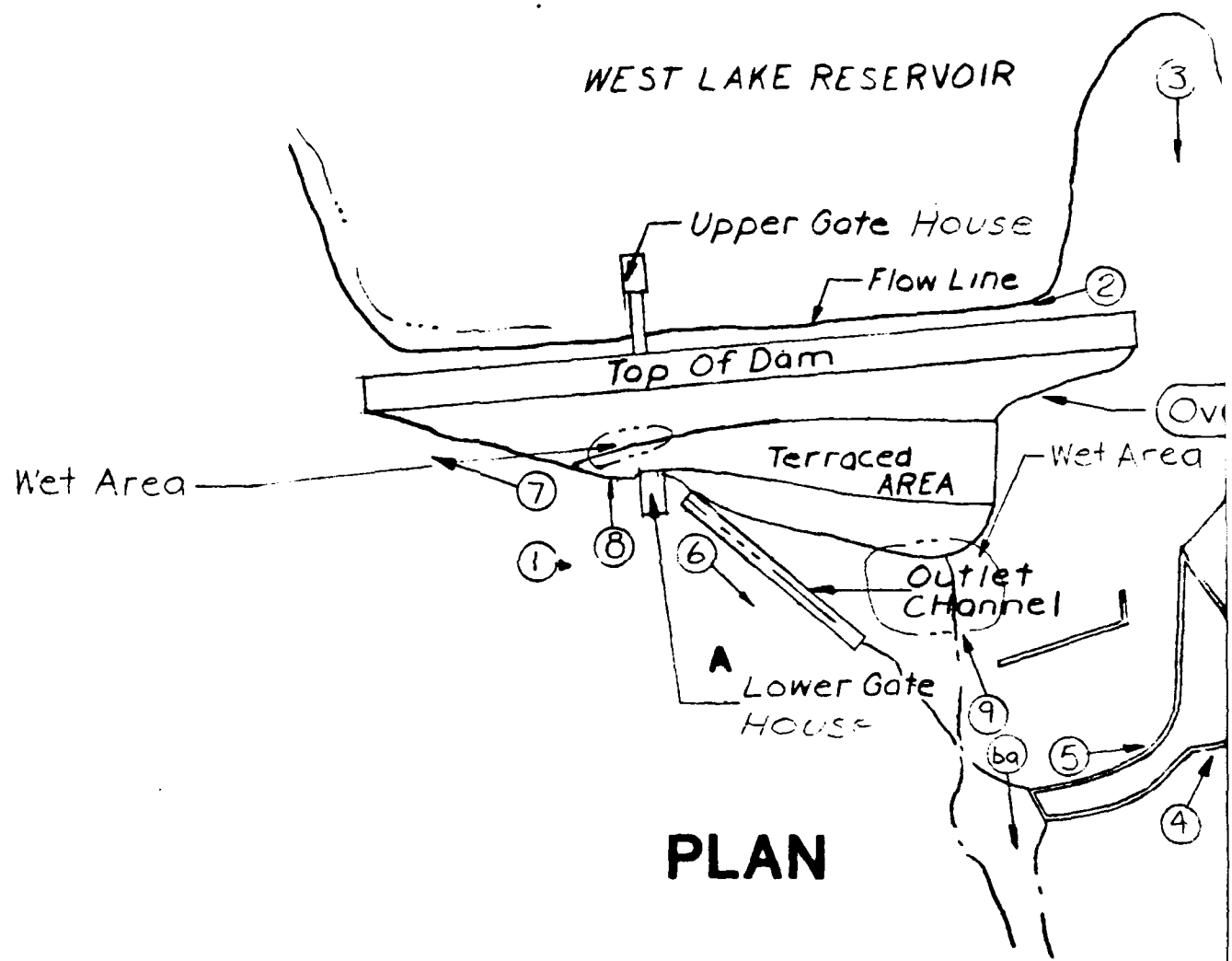
NOT TO SCALE

SCALE AS SHOWN

DATE JULY 1980

APPENDIX C

PHOTOGRAPHS


WEST LAKE RESERVOIR
3
Upper Gate House
Flow Line
2
Top Of Dam
Ov
Wet Area
Terraced AREA
Wet Area
7
8
1
6
Outlet Channel
A
Lower Gate House
9
ba
5
4

PLAN

I

NO

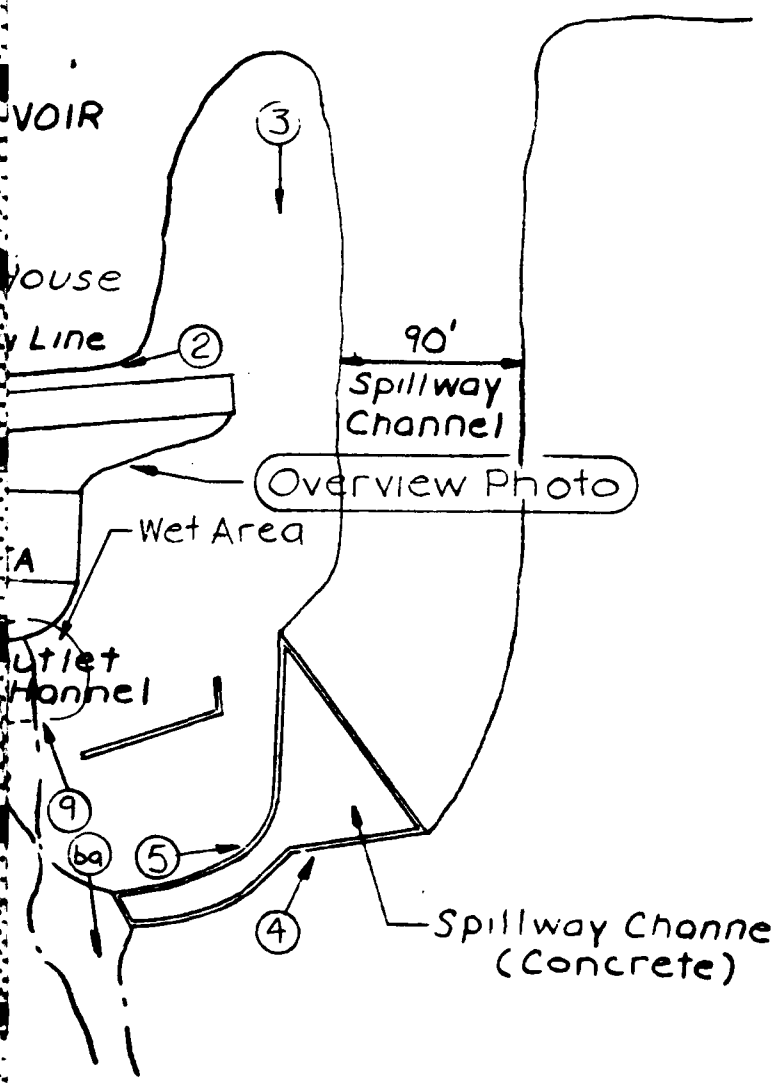


PHOTO LOCATION PLAN

PLATE 2

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WEST LAKE RESERVOIR DAM

II

NOT TO SCALE

SCALE AS SHOWN

DATE JULY 1980

PHOTO 1

DOWNSTREAM FACE OF DAM - LOWER GATE HOUSE

PHOTO 2

CREST OF DAM - RIP RAP PROTECTION - UPPER GATE HOUSE

PHOTO 3

SPILLWAY - DOWNSTREAM

PHOTO 4

SPILLWAY CHANNEL - UPSTREAM

PHOTO 5

SPILLWAY CHANNEL - UPSTREAM

PHOTO 6

BLOWOFF CHANNEL - DOWNSTREAM

PHOTO 6a

VIEW LOOKING DOWNSTREAM

PHOTO 7

DRAINAGE EROSION - SOUTH ABUTMENT

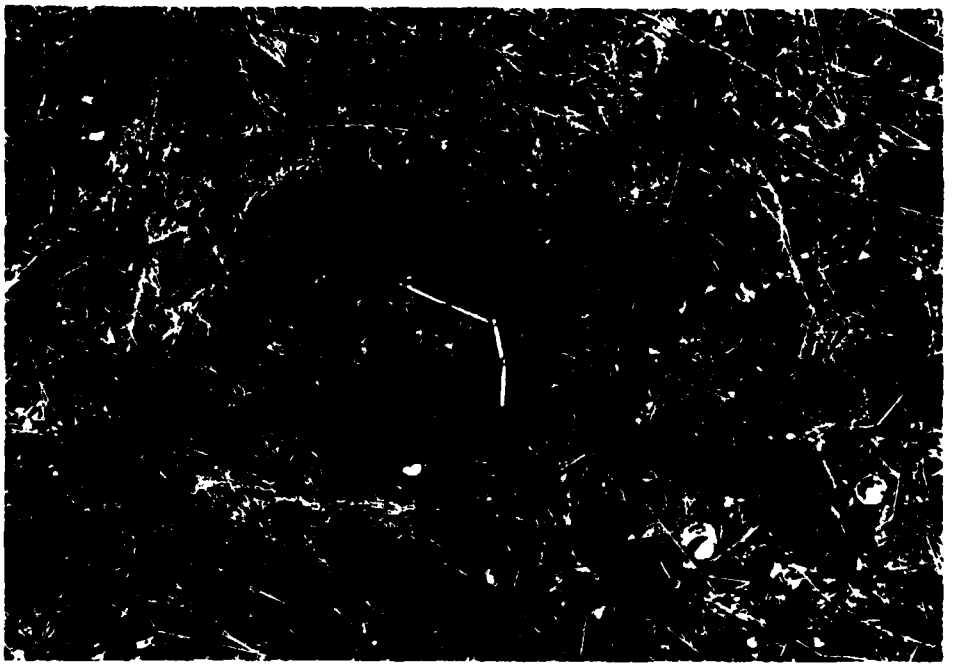


PHOTO 8

SEEPAGE - DOWNSTREAM FACE

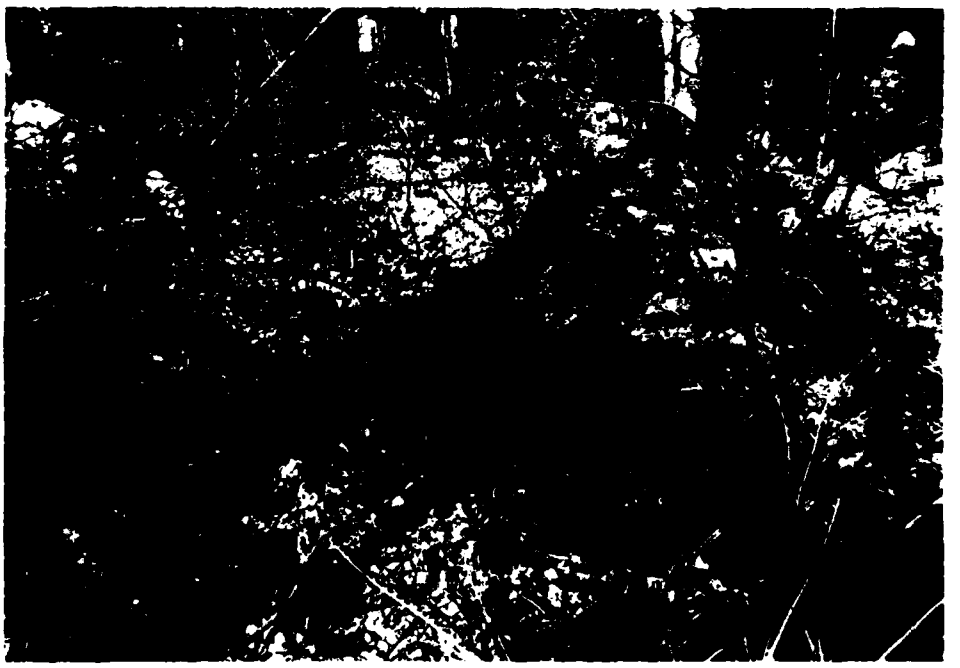
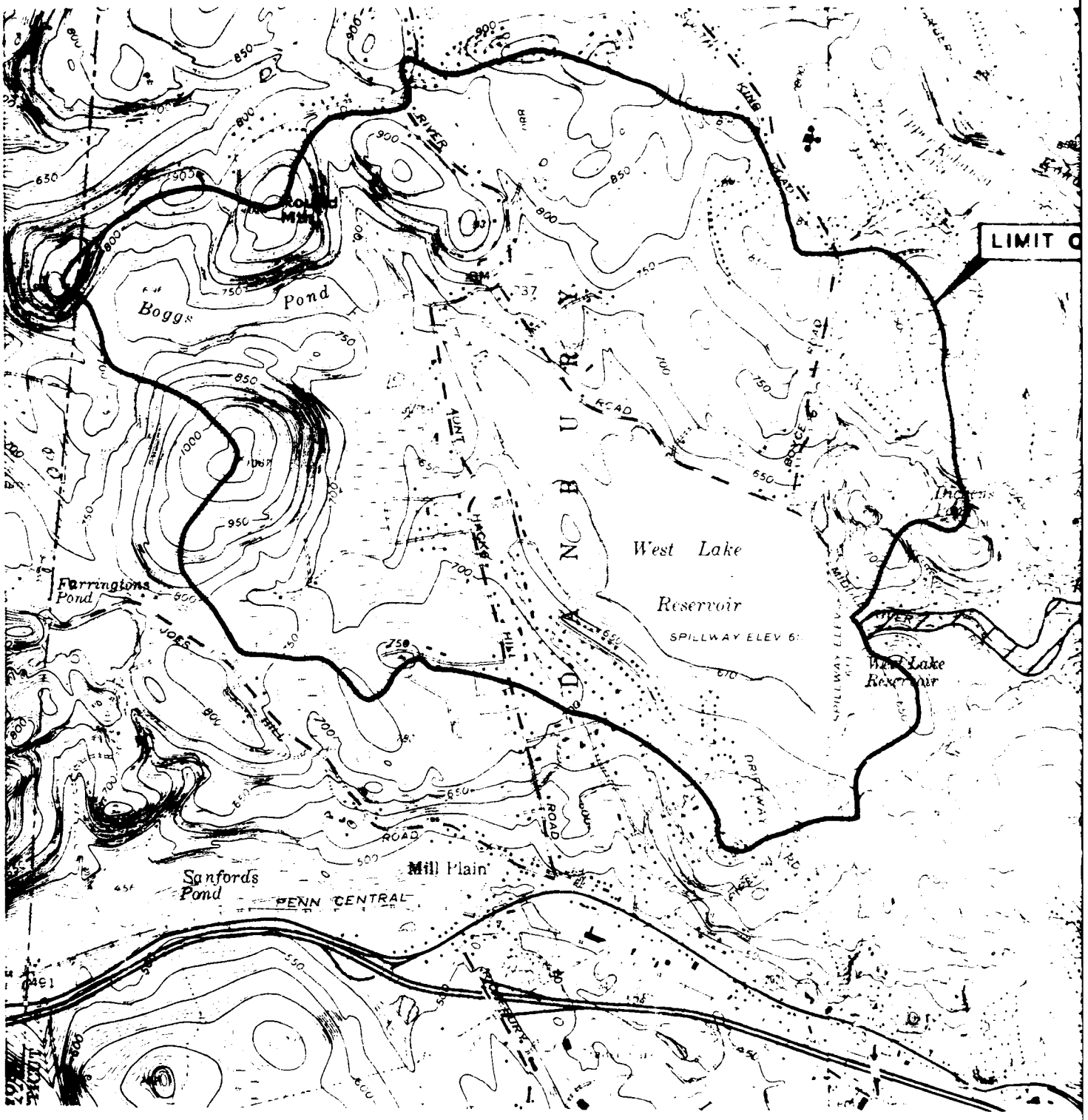


PHOTO 9

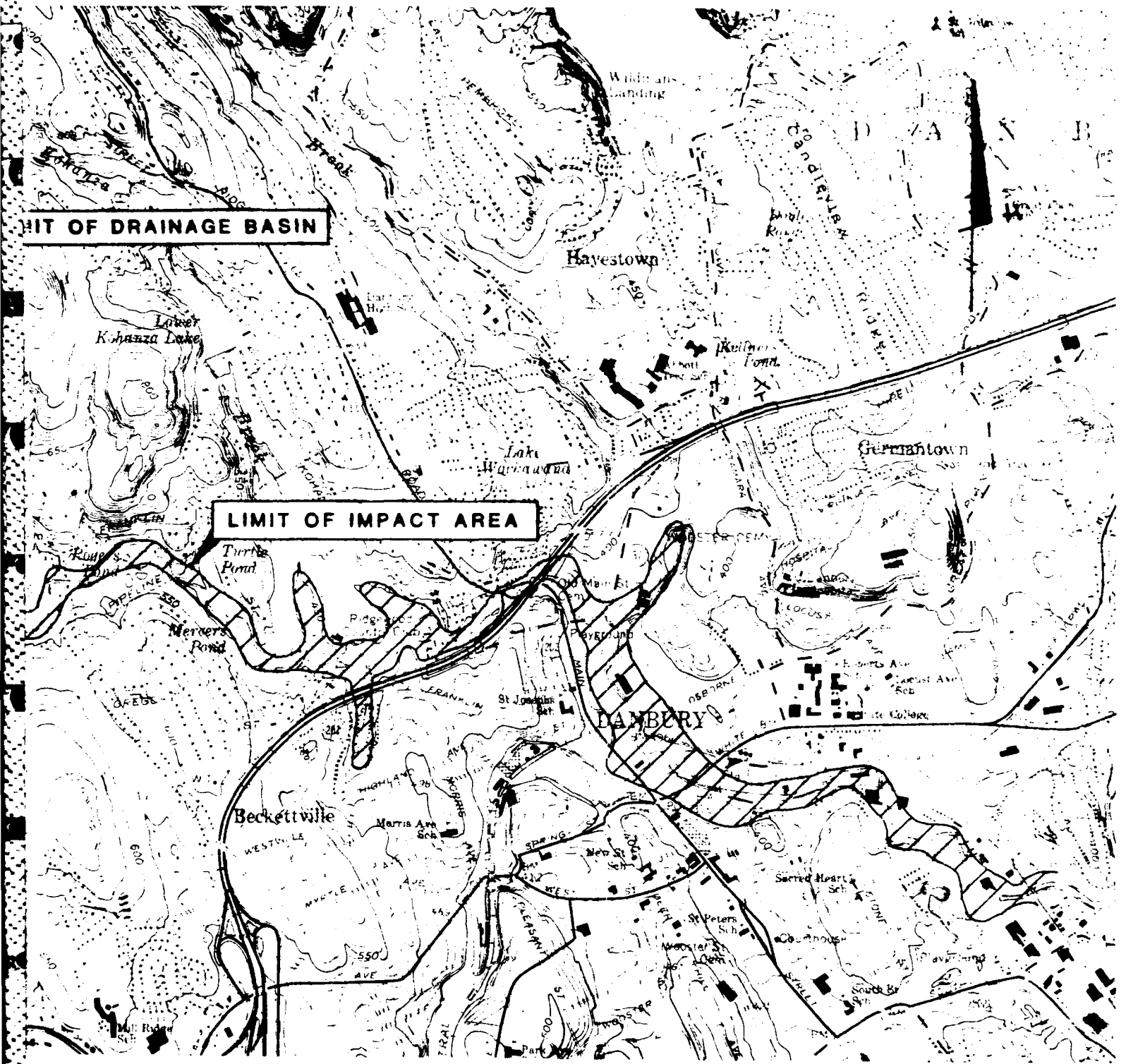
SEEPAGE NEAR TOE OF DAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS


Bogg's Pond
Farrington's Pond
Sanford's Pond
West Lake Reservoir
SPILLWAY ELEV 6
Mill Plain
PENN CENTRAL
ROAD
LIMIT O

I



II

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PLATE 3

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

WEST LAKE RESERVOIR DAM

			SCALE AS SHOWN
			DATE JULY 1980

STORCH ENGINEERS
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Planners - Environmental Consultants

JOB Phase I Dam Inspection - #4463
SHEET NO 1 OF 9
CALCULATED BY GG DATE 4/25/80
CHECKED BY RCC DATE 4/80

Determination of PMF

NAME OF DAM WEST LAKE RESERVOIR DAM

DRAINAGE AREA 3.3 SM

INFLOW 1975 cfs/SM (rolling terrain)

PMF = 1975(3.3) = 6517.5 cfs

½PMF = ½ 6517.5 = 3258.75

Estimating the effect of surcharge storage on the Maximum Probable Discharges

½ PMF

1. Q_{P1} = 6520 cfs — 3260 cfs
2a. H_1 = 5.42' (elev.) — 4.2'
b. $STOR_1$ = 8.5" — 6.4"
c. $Q_{P2} = Q_{P1}(1 - STOR_1/19)$ = 3600 cfs — 2160 cfs
3a. H_2 = 4.35' $STOR_2$ = 6.8" — 3.7' 5.7"
b. $STOR_A$ = 7.66" — 6.0"
Q_{PA} = 3890 cfs — 2230 cfs
H_A = 4.5' $STOR_A$ = 7.1" — 3.75' 6.0"

PMF = 3890 cfs ½PMF = 2230 cfs

Capacity of the spillway when the pond elevation is at the top of the dam

Q = 1950 cfs or 50 % of the PMF

87.4 % of ½ PMF

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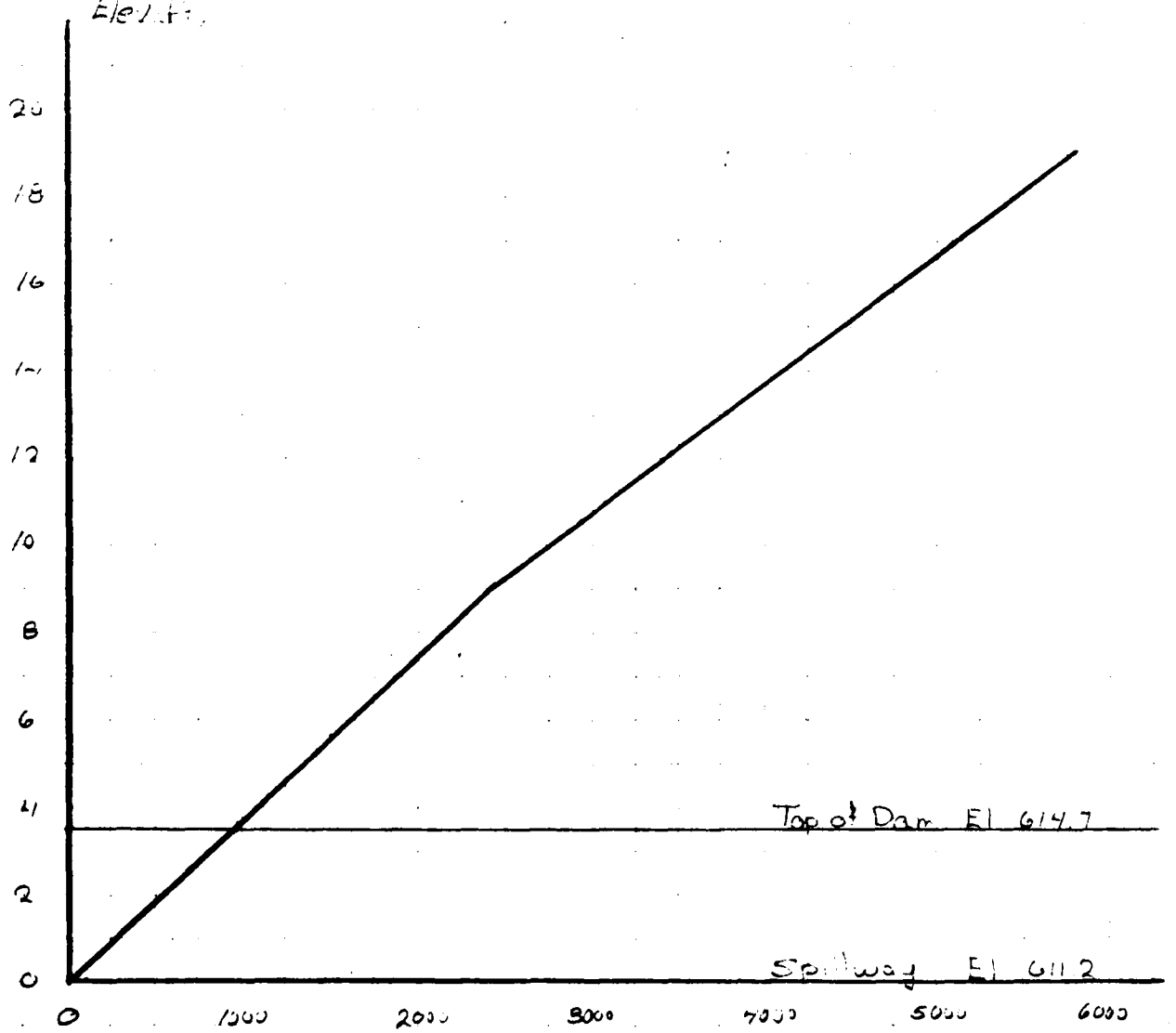
JOB Phase I Dam Inspection 4463
SHEET NO 4 OF 9
CALCULATED BY GJG DATE 4/16/80
CHECKED BY [illegible] DATE [illegible]

AREA - CAPACITY

Name of Dam: WEST LAKE RES. DAM

ELEV	DEPTH	AREA	AVG. AREA	VOL	Σ VOL
0.0		247.9			0.0
	9.0		268.1	2413	
9.0		288.3			2413
	10.0		339.3	3393	
19.0		390.3			5806

Storage below Spillway is approximately 2440 Ac ft



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JOB Phase I Dam Inspection 4463
SHEET NO 8 OF 9
CALCULATED BY SJG DATE 4/6/90
CHECKED BY JJC DATE 4/7/90

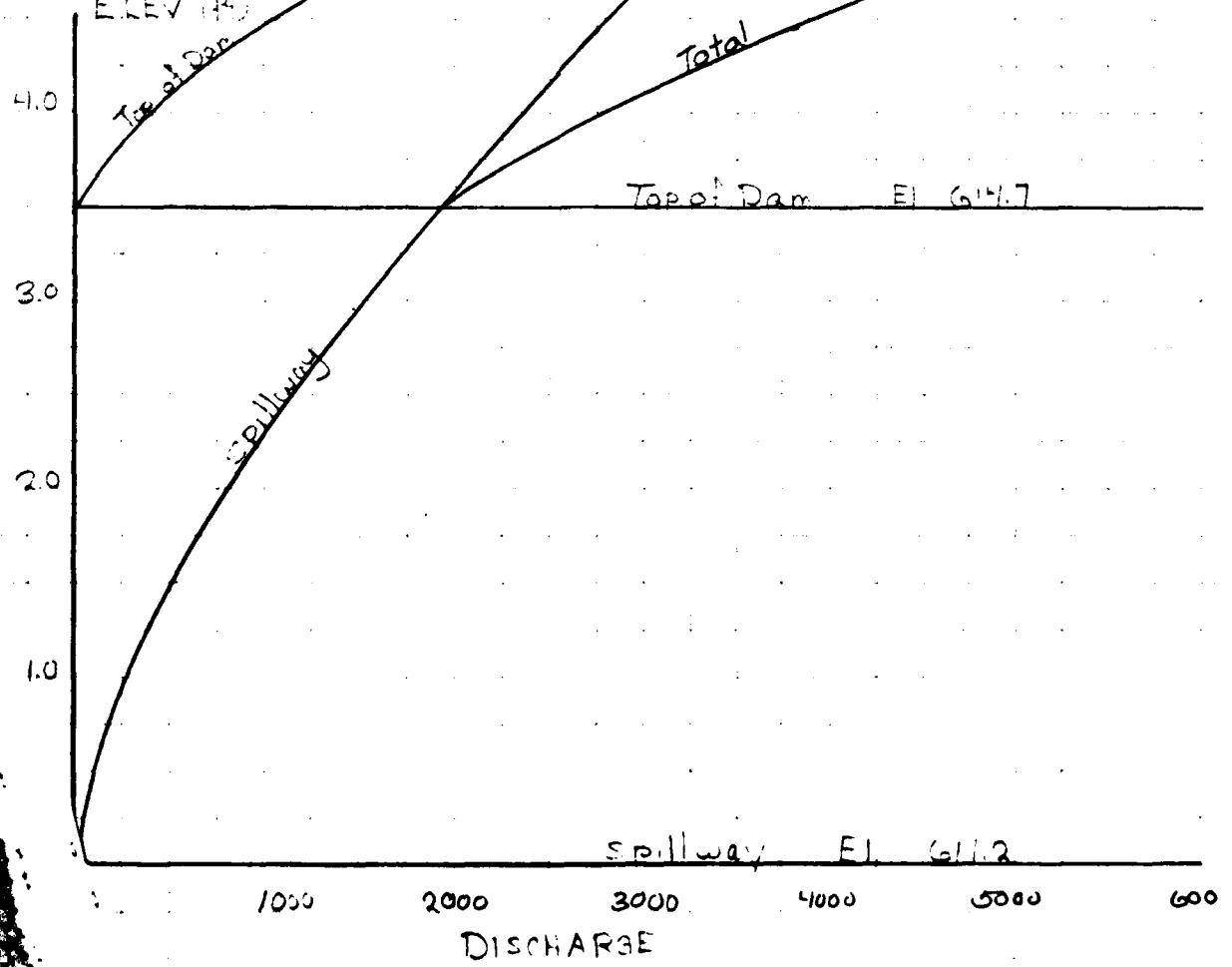
Stage Discharge

NAME OF DAM West Lake Res Dam

$Q = CLH^{3/2}$

	Spillway I *				Spillway II				Dam				
Elev	C	L	H	Q	C	L	H	Q	C	L	H	Q	QT
	H_T	90	d_c										
0.76	.277		0.5	181					2.7	400	0.5	880	
1.49	.489		1.0	516					2.63	400	1.0	1050	
2.18	.681		1.5	924					2.63	400	1.5	1930	
2.95	.959		2.0	1490					2.63	400	2.0	2975	
3.68	1.18		2.5	2075					2.63	400	2.5	4185	
4.41	1.41		3.0	2750									
5.13	1.63		3.5	3490									
5.85	1.85		4.0	4280									

* Equation 8-60; Handbook of Hydraulics 4th King & Brater



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JOB Phase I Dam Inspection - #4463
SHEET NO 4 OF 9
CALCULATED BY GLS DATE 4/25/80
CHECKED BY BDC DATE 7/14/80
Downstream Hydrographs

"Rule of Thumb" Guidance for Estimating Downstream Failure Hydrographs

NAME OF DAM West Lake Reservoir Dam

Section I at Dam

1. $S = \frac{3430}{8/27\ W_b\sqrt{g}}$ Acft
2. $Q_{P1} = 8/27\ W_b\sqrt{g}\ Y^{3/2} = 8/27\ (120)\sqrt{32.2}\ 33^{1.5} = 38{,}250$ cfs
3. See Sections

Section II at

4a. $H_2 =$ 10.6' $A_2 =$ 3800 $L_2 =$ 2000 $V_2 =$ 174 Acft

b. $Q_{P2} = Q_{P1}\ (1-V_2/S) =$ 36,310 cfs

c. $H_2 =$ 10.3 $A_2 =$ 3750

$A_A =$ 3775 $V_2 =$ 173 Acft

$Q_{P2} = 38250(1 - 173/3430) = 36320$

Section III at

4a. $H_3 =$ 13.0 $A_3 =$ 2650 $L_3 =$ 4300 $V_3 =$ 262 Acft

b. $Q_{P3} = Q_{P2}\ (1-V_3/S) =$ 33,400 cfs

c. $H_3 =$ 12.2 $A_3 =$ 2550

$A_A =$ 2600 $V_3 =$ 256 Acft

$Q_{P3} = 36320(1 - 256/3257) = 33{,}465$ cfs

Section IV at

4a. $H_4 =$ 16.7 $A_4 =$ 2100 $L_4 =$ 4100 $V_4 =$ 198 Acft

b. $Q_{P4} = Q_{P3}(1-V_4/S) =$ 30880 cfs

c. $H_4 =$ 16.0 $A_4 =$ 1950

$A_A =$ 2025 $V_4 =$ 190 Acft

$Q_{P4} = 33{,}465\ (1 - 190/3001) = 31{,}346$ cfs

Downstream Hydrographs (Continued)

Section V at

4a. H_5 = 14.8 A_5 = 5000 L_5 = 6500 + 3500 dead storage V_5 = 1147 Acft

b. $Q_{p5} = Q_{p4}(1-V_5/S)$ = 19,360 cfs

c. H_5 = 12.2 A_5 = 3700

A_A = 4350 V_5 = 998 Acft

Q_{p5} = 31346 (1 − 832/2818) = 22,068 cfs

Section VI at

4a. H_6 = 13.0 A_6 = 4000 L_6 = 4000 V_6 = 367 Acft

b. $Q_{p6} = Q_{p5}(1-V_6/S)$ = 17,600 cfs

c. H_6 = 11.7 A_6 = 3400

A_A = 3700 V_6 = 340 Acft

Q_{p6} = 22,068 (1 − 340/1813) = 17,930 cfs

Section VII at

4a. H_7 = 11.7 A_7 = _____ L_7 = _____ V_7 = _____ Acft

b. $Q_{p7} = Q_{p6}(1-V_7/S)$ = _____ cfs

c. H_7 = _____ A_7 = _____

A_A = _____ V_7 = _____ Acft

Q_{p7} =

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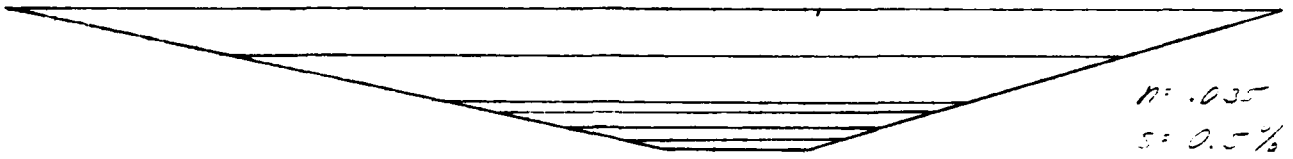
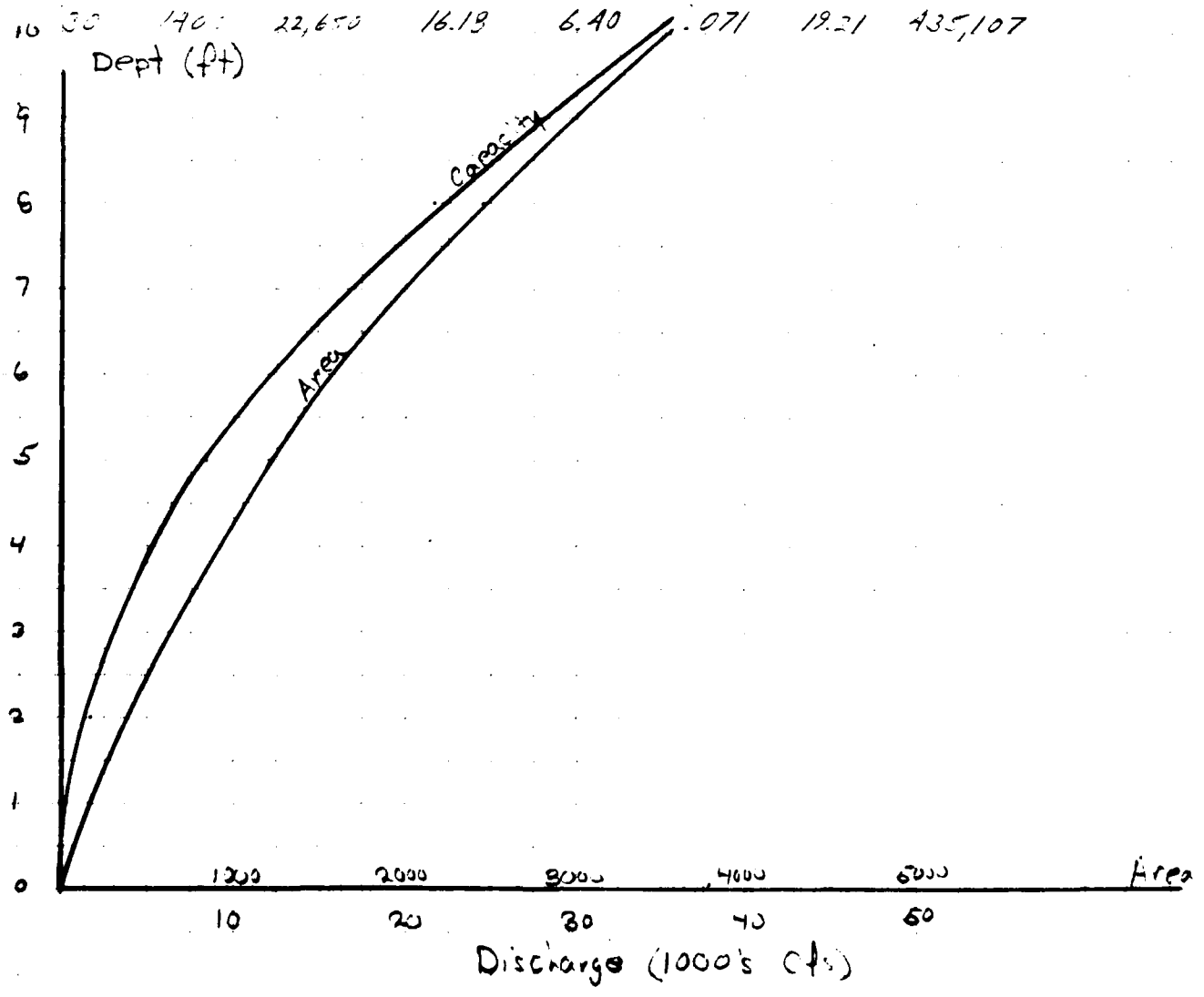
JOB [illegible]
SHEET NO 6 OF 9
CALCULATED BY EAH DATE 7/30/80
CHECKED BY BDC DATE 7/14/80
SCALE Section II



D	A_P	A	R	R^⅔	S^½	V	Q
2	240	355	1.60	1.37	.071	4.11	1582
5	345	1212	3.51	2.31	.071	6.94	8411
8	490	2448	5.10	2.96	.071	8.89	21,763
10	575	3525	6.13	3.35	.071	10.06	35,462
20	975	11,000	11.28	5.03	.071	15.10	166,100
30	1401	22,650	16.19	6.40	.071	19.21	435,107



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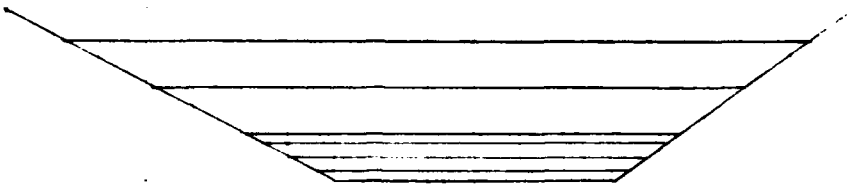
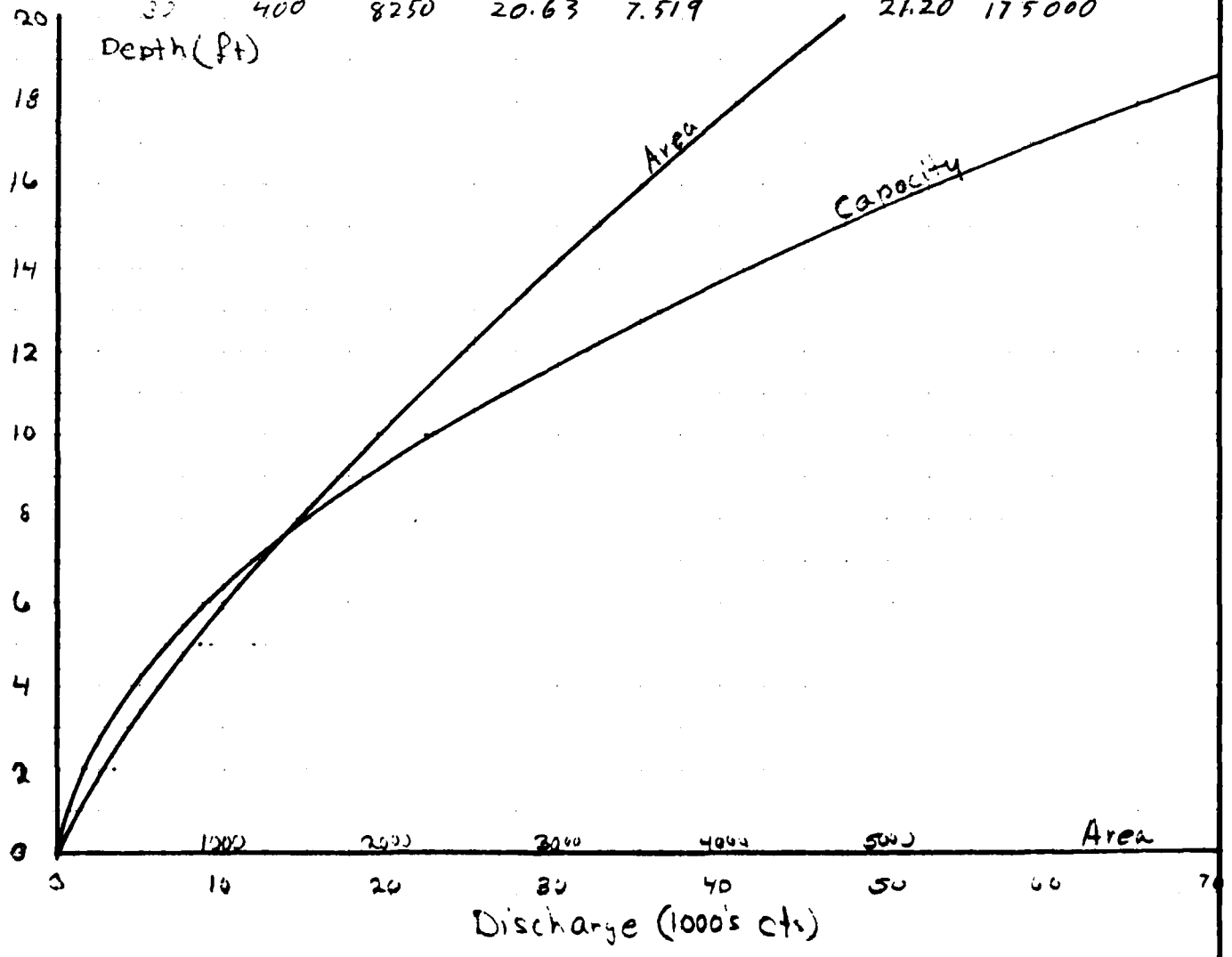
JOB 81463
SHEET NO 7 OF 4
CALCULATED BY BAF DATE 3/20/80
CHECKED BY BDC DATE 7/14/80
SCALE Section III



n = .05
S = 0.0

E		A	R	R^2		V	Q
	170	320	1.88	1.5243	.094864	4.30	1375
	195	862	4.4	2.7		10.8	9315
	220	1480	6.727	3.563		10.04	14870
	235	1925	8.191	4.063		11.46	22050
	320	4700	14.68	5.997		16.91	79470
	400	8250	20.63	7.519		21.20	175000



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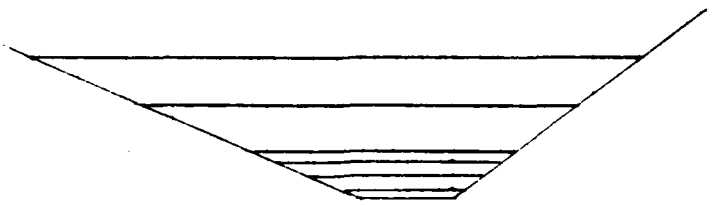
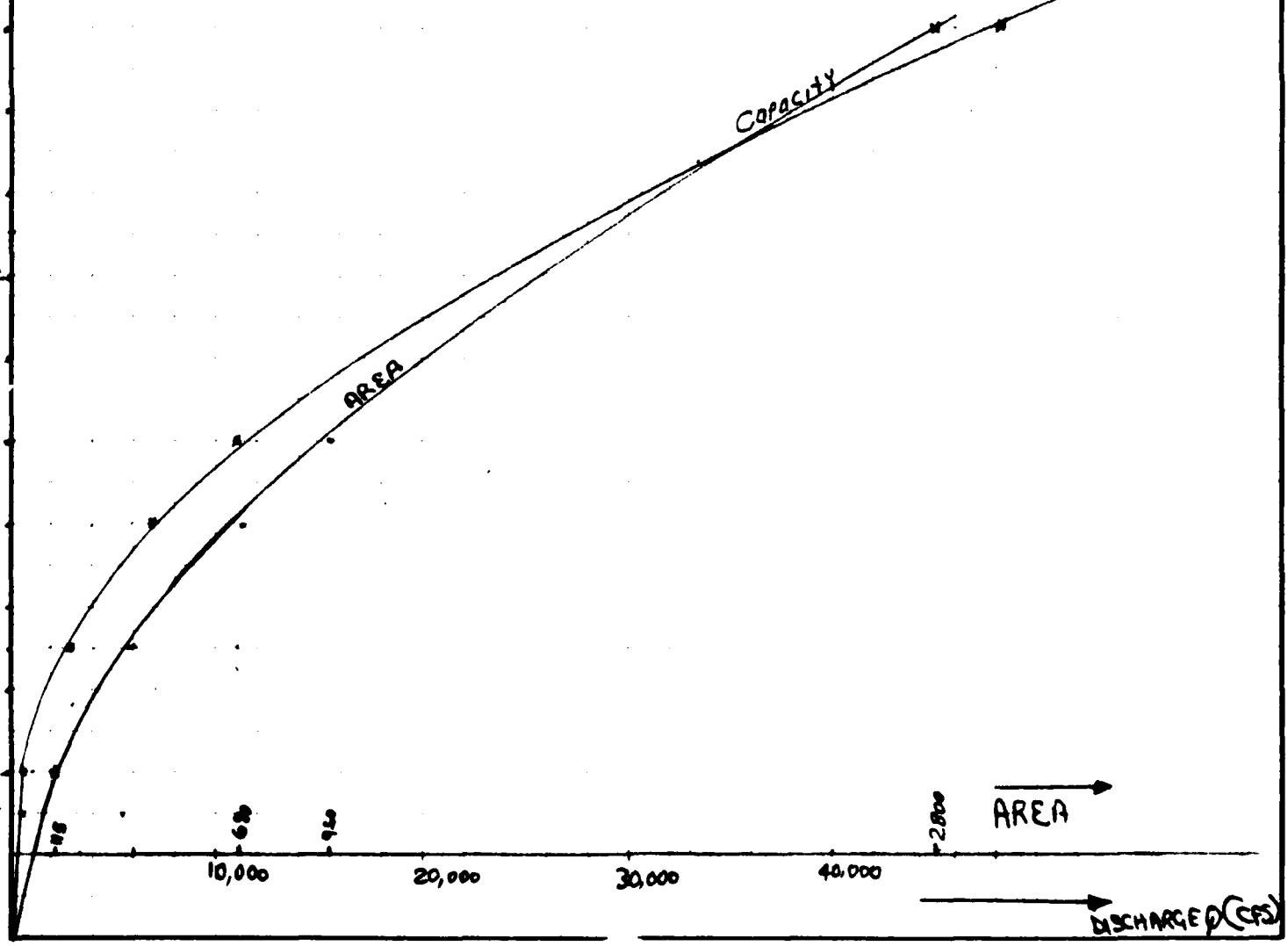
Planners - Environmental Consultants

JOB [illegible]
SHEET NO 6 OF
CALCULATED BY [illegible] DATE [illegible]
CHECKED BY BDC DATE 7/14/80
SCALE Section IV



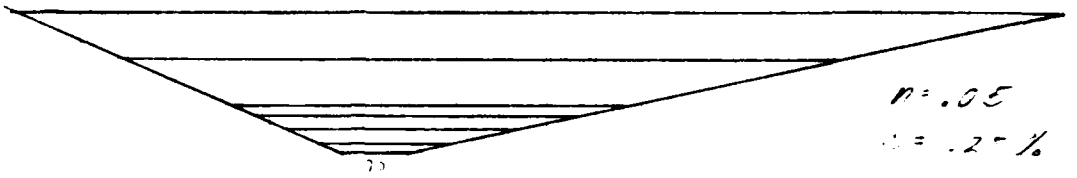
$n = .05$
$S = 1.2\%$

D	WP	A	R	$R^{2/3}$	$S^{\frac{1}{2}}$	V	Q
2	65	115	1.77	1.46	0.11	4.77	549
5	93	358	3.85	2.46	0.11	8.04	2879
8	120	680	5.67	3.18	0.11	10.39	7069
10	140	950	6.79	3.58	0.11	11.70	11119
20	230	2800	12.17	5.29	0.11	17.29	48423
30	325	5625	17.3	6.69	0.11	21.87	123,024

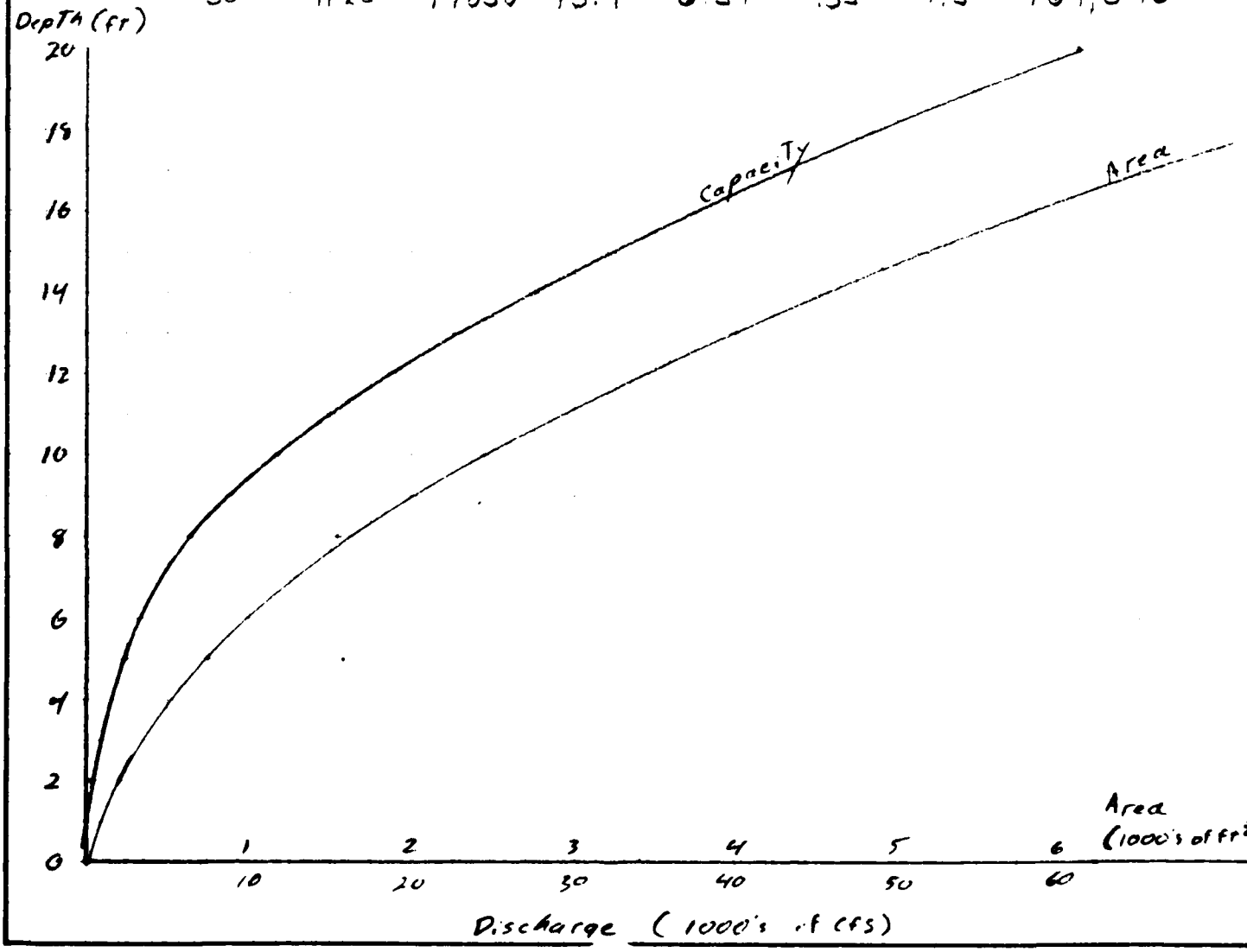


STORCH ENGINEERS/STORCH ASSOCIATES
Engineers - Landscape Architects
Planners - Environmental Consultants

JOB [illegible]
SHEET NO 9 OF [illegible]
CALCULATED BY [illegible] DATE [illegible]
CHECKED BY BDC DATE 7/14/20
SCALE Section V - VI



D	W	A	R	$R^{\frac{2}{3}}$	$S^{\frac{1}{2}}$	V	Q
2	130	200	1.5	1.3	.05	1.56	400
5	240	725	3.0	2.09	.05	3.11	2,260
8	370	1560	4.6	2.77	.05	4.1	6,430
10	420	2450	5.8	3.2	.05	4.8	11,870
20	760	5300	10.9	4.96	.05	7.4	61,200
30	1120	17850	15.9	6.39	.05	9.5	169,540



APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
CT	70	110	01	001	05				WEST LAKE RESERVOIR DAM	4124.5	7330.8	14JUL80

POPULAR NAME	NAME OF IMPOUNDMENT
	WEST LAKE RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	10	TRIBUTARY OF MOOSE BROOK	DANBURY	2	51000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
ER	1905	S	32	32	3440	2440	NED	N	N	N	N	

REMARKS

ESTIMATE

DIS HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
	450		120	1950	14500											

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF DANBURY	W. S. MORTON, ENGINEER	NOT KNOWN

REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
		NONE	NONE

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
STORCH ENGINEERS	21AUG80	PL-92 367

REMARKS

TEST PIT

END

FILMED

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